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DISCUSSION

OF

MR. JAMES B. EADS' PROJECT

FOR

CONSTRUCTION OF JETTIES

AT THE

MOUTH OF THE MISSISSIPPI RIVER,

BY

15-15-8  
ROBERT E. McMATH,

Civil Engineer, St. Louis, Mo.



WASHINGTON, D. C.

1874.

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## JETTIES AT THE MOUTH OF THE MISSISSIPPI RIVER.

This proposition is a measure of so much importance in itself, and as a precedent for departure from old methods of constructing public works, and as encouraging the presentation of private schemes, that free discussion should precede decisive action. I propose to discuss it in three views:—1st. As an engineering proposition based on scientific principles. 2d. The practical bearings of the bill as it is reported. 3d. As a precedent in legislative policy.

As an engineering proposition the author has carefully endeavored to prevent criticism, by concealing what he proposes to do, conveying the impression that he is in possession of the secrets of nature, and he alone of living engineers is endowed with the natural ability and the knowledge acquired by experience requisite to carry out the work. Notwithstanding this concealment of the practical features of his plans, the scientific theory and reasoning on which the plans are based are before us, in his letter to Mr. Windom, Chairman Senate Committee on Transportation Routes to the Seaboard, and additional light is thrown on the subject by his pamphlet entitled "Correspondence between the business men of New Orleans and James B. Eads," which I will refer to under the designation of the Windom and Higby letters.

The first point of issue occurs in the 2d paragraph of the Windom letter, and is a question of fact. He, speaking of the Mississippi as a transporter of solid matter to the sea, says: "By far the greatest portion is, however, transported in suspension", having just said that "a small portion \* \* \* is rolled along the bottom."

Humphreys and Abbot in *Physics and Hydraulics of the Mississippi River*, page 149, say: "Besides the amount held in suspension, the Mississippi pushes along into 'the Gulf large quantities of earthy matter.'" They also say, page 446; "The current in the South-west Pass is quite equal to pushing this material along the bottom, 'both when the river water begins to ascend upon the salt water of the gulf, the 'rolling material is not carried with it, but is left upon the bottom in the dead angle 'of the salt water. A deposit is thus formed whose surface is along or near the line 'upon which the fresh water rises on the salt water as it enters the Gulf. *This action 'produces the bar.*" To make the issue upon this matter more distinct I quote from the Higby letter, page 10: "While the indefatigable Professor (Forshey) was experimenting with a key with two valves in it to find out what was going on in the bottom 'of the river, and was publishing to the world the new discovery that by far the 'greatest portion of its deposit was pushed along its bed, and that sand was not carried by it in suspension, I, (Eads) was daily learning the falsity of these theories 'by hard work on the river bottom, in the diving bell," &c. He also says, page 13, of Higby letter: "What I know of the Mississippi are facts, and facts are the uncut 'jewels which grind false theories to powder." Now to settle this question of facts we will introduce testimony which Mr. Eads cannot impeach, though others may see reason for doubting the veracity of the witness. In the report of the Engineer in chief of the Illinois and St. Louis Bridge Company, dated St. Louis, May, 1868, on title page, and June 1st, 1868, at the close, with the signature of James B. Eads, page 21, we read: "I had occasion to examine the bottom of the Mississippi, below 'Cairo, during the flood of 1851, and at 65 feet below the surface, I found the bed of 'the river, *for at least three feet in depth, a moving mass, and so unstable that, in 'endeavoring to find footing on it beneath the bell, my feet penetrated through it 'until I could feel, although standing erect, the sand rushing past my hands, driven 'by a current apparently as rapid as that at the surface. I could discover the sand 'in motion at least two feet below the surface of the bottom, and moving with a 'velocity diminishing in proportion to the depth at which I thrust my hands into it."*

Returning to the Windom letter, it is evident that he is speaking of the Mississippi, as to its general characteristics, and not of the bars at the mouth. Humphreys and Abbot, too, are discussing the general character of the river. When they speak of the bar they refer to the observations made by Gen. George G. Meade, made in 1831. Mr. Eads' intent in the bridge report clearly transfers his facts observed below Cairo, to Saint Louis, and hence admits the truth of all Humphreys and Abbot (or Professor Forshey) asserted in regard to the river generally. As neither Humphreys and



Abbot or Mr. Eads distinctly claim to have made direct observation of the facts at the bar, we have only the authority of General Meade, whose repute as a careful observer and truthful interpreter is beyond question. It will hereafter appear how important it is to Mr. Eads' project that no material should be rolled along the bottom at the pass, and that the uncouth jewel of a fact, that material is there rolled, grinds his false assumption to powder.

Condensing Mr. Eads' theory of silt bearing rivers as set forth in the Windom letter paragraphs 2 to 9 inclusive, a fair statement would be: That the Mississippi is a transporter of solid matter. That the proportion of sediment is in direct proportion to the velocity of flow, modified by depth. That a given current is always charged with the full load of solid matter that it is able to carry. That the causes controlling the velocity of a stream and those which give it ability to carry sediment are opposing forces, and that, consequently, a nice equilibrium is established between the current and the load carried at all times; therefore, any increase of velocity causes an instant attack upon the banks or bottom to obtain the additional material required to satisfy the increased carrying power, and, on the other hand, any decrease of velocity involves the deposit of a proportional part of the load previously borne. These theoretical propositions (except the statement as to "opposing forces," which is an obscure passage, and untrue in the only interpretation that can be given, for carrying power increases with the velocity) are plainly derived from the papers of Mr. Login, read before the British Association, differing only by substituting "modified by depth" for "inverse ratio to depth," and, in suppression of the fundamental principle, that the taking up and transportation of solid matter, being mechanical work, must consume force, which force is derivable from the current alone: therefore, transportation of matter is at the expense of velocity\*. This theory was advanced by Mr. Login as the result of his observation on rivers in India, and examination and test elsewhere were desired to establish or disprove them: not having been so tested, they are not accepted truths, but hypotheses. But assuming that, as modified by Mr. Eads, these propositions are true, his own theory overthrows even the possibility of success of his project with all the weight of a demonstration. For, his nicely adjusted river, in which (using his own words, paragraph 13, Windom letter) "a given current will keep in suspension a corresponding quantity of solid matter; that at a less velocity a portion of it will be deposited and taken up again at a "greater," must, at the mouth of the pass, encounter the varying tides, waves, and currents of the gulf, and at this point of meeting, the bar is found. Material rolled on the bottom must here stop; for, the moving force, the river current, is no longer in contact with the bottom, by his own admission, as he says, paragraph 14, Windom letter: "At the bar the river has its banks of earth no longer, but it still flows between banks of salt water, and over a *bottom of brine* instead of mud," hence his anxiety to deny the fact that material is so moved; be it much or little, it must stop. How is it with the material in suspension? The "feeble tides of the gulf average less than 14 inches in height, and while they simply act to raise and lower the fluid channel through which the river flows after leaving the land, they really oppose no barrier to its onward progress". The *average* velocity of the current is maintained: "the retardation due to the flood-tide being compensated by the increased speed induced by the ebb": in this verbatim quotation, retardation due to flood-tide is admitted, and increased speed ascribed to the ebb. Retardation, according to theory, inevitably involves partial deposit of load, and *averaging* velocities is absolutely excluded. The theory also says, that increased current will pick the deposit up again, and the ebb tide provides the increased current to do the work, if the material were within its reach, but Mr. Eads seems to have forgotten "the *bottom of brine* instead of mud," he is to have at and beyond the bar. The sediment must, as long as sand and salt water retain their present characters, drop through the brine bottom and fall on the outer slope of the bar, just as it always has heretofore, his new theory not carrying it any further than the river did before any theory was formed. His jetties therefore, introduce no new conditions, except to restrict the lateral spread of the waters, and while, on the one hand, they will cause river water to be projected into the gulf at a greater velocity and more compact volume than now, they will, on the other hand, bring to the narrowed pass all the material, suspended and rolling, that

\*NOTE.—The restoration of Mr. Login's theory explains the opposing forces mentioned by Mr. Eads, his omission to state the theory while giving its logical sequence, seems to show that he failed to get a clear understanding of a matter very clearly expressed in the original.

is now scattered over the wide expanse of the natural mouth, and drop the greater part at the mouth of the jetties, where a new bar will be built up from the moderate depth attained at the outer end of the jetties, and not from the depths found at a distance of many miles as Mr Eads claims. To accomplish what he asserts would require a floating trough in extension of the natural banks, to provide a bottom to sustain flood-tide deposits within the reach of ebb scour, until great depths are reached.

The resistance of the tides causes the velocity at South-West Pass to vary from 2.50 feet per second to 4.17, or a difference of 1.67 feet per second; a velocity of .50 feet per second, being barely able to move fine sand, it appears that the flood velocity can carry but 54 per cent. of the load of the ebb, whence it would appear that a large percentage of the material brought to the bar in suspension during flood-tide must be deposited on and through the *brine bottom*.

Another theory quoted by Mr. Eads from R  vy's "Hydraulics of great Rivers" says, that the current is doubled by doubling the depth, and trebled when it is three times as deep, the volume and inclination being unchanged. From this he argues that narrowing the pass will send the water into the gulf with greatly increased velocity, and distribute the sediment more widely. If we apply this theory to Mr. Eads' project, the result of deepening the pass from 15 feet to the 60, which, he says, we will inevitably have at the mouth of the jetties, will be to increase the velocity from 2.50 feet per second at flood-tide to 10 feet, and from 4.17 to 16.68 feet per second at ebb tide, velocities corresponding to 6.82 and 11.372 statute miles per hour which would be nearly as formidable obstructions to commerce as the present bar. This theory of R  vy's is absurd on its face, and is only noticed to show how little study Mr. Eads can have given to the subject of hydraulics, since he did not see that his theory ends in *reductio ad absurdum*, and the danger of putting into such hands interests of so great importance as are involved at the mouth of the Mississippi.

But, it may be said that Mr. Eads and associates assume all the risks attending complete success, therefore the public are not interested in the science or practicality of his plans. We will therefore examine the practical features of his proposition.

In the light of the foregoing expose of the fallacy of his reasoning, it would be difficult to find any good reason why the bill should authorize James B. Eads and associates to do this work to the exclusion of all competition; for the credit of the nation it is to be hoped, that there are many other engineers who could make a more satisfactory exhibit of their ability to project works, and arrange details, and it is not unlikely that capital could be found to embark in the enterprise at lower rates than Mr. Eads offers.

The original bill since its recommittal has probably been materially changed in many respects, and it would be useless to call attention to many of the verbal changes that the original required. But it should prescribe limits of time, and restriction upon the discretion given to the contractor by providing authority to revise, approve, or disapprove of plans, and to revoke the contract for cause, make payments definite in time and amount, forbid payment of interest; and if bonds are issued, they should be currency bonds, or if gold, to be issued at the market value, instead of par.

Provision for the safety of work should be made under general law, and no mention made of the subject in a bill which is in reality a contract, otherwise an unlimited expense and responsibility will be thrown upon the government. Natural and accidental obstructions from wrecks, &c. should be removed, and the means of doing so provided beyond contingency; otherwise all the risks of success will be assumed by the United States, as a small obstruction, if allowed to remain, can be made to bear the blame of all failures, the burden of disproving such claims resting with the United States. A per centage of each payment should be retained until the succeeding one is earned. The contract should be unassignable for the same reasons that all other government contracts are, and just rights of parties have never been impaired by the provision.

As a legislative policy, the innovation of making contracts by act of Congress instead of through an executive department, is questionable, to say the least. And to give attention to projects whose sole recommendation is the pretence that the government cannot in any case be the loser, is but to encourage what has already been found worthy of condemnation,—the Sanborn contracts were based on the same principle—which is always intended to deceive, until contracts become vested rights and



are not easily annulled. The present party take no risk worthy of mention, and except that the manifest absurdity would suggest the trick, could safely offer to bridge the Atlantic on the same terms, the idea being to get big pay for the first and easy steps, and no penalty attached to abandoning at will, when work becomes costly.

Again, to entertain this project would be to open the door to a flood of schemes that would swamp all proper business, foster corruption, and put our highway in the hands of monopolists. Every year projects would be submitted to improve harbors and rivers, and look to tolls for reimbursement; indeed, such are now talked of among speculators.

ROB'T. E. McMATH,  
CIVIL ENGINEER.









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